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‘It’s more than a prop’: Professional development session strategies as sources of teachers’ self-efficacy and motivation to teach outside the classroom.

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Abstract

This paper discusses findings from a small-scale empirical exploration of how professional development (PD) programme session strategies influence secondary science teachers' practice. It draws on a series of session questionnaires, semi-structured interviews and lesson observations from six secondary science teachers participating in a two year outdoor teaching PD programme in England. This article explores session strategies as sources of self-efficacy resulting in practice change. It is argued that strategies most influential are those that combined several self-efficacy sources. However, alongside self-efficacy, the motivating role strategies play are important to the successful outcome of PD programmes.

Keywords

Self-efficacy, Professional development, Motivation, Outdoor science teaching

1 Teaching outside the classroom

Secondary teachers in England infrequently incorporate outdoor learning into their practice (O'Donnell, Morris, & Wilson, 2006; Power, Taylor, Rees, & Jones, 2009). The outcome is that few students engage in 'authentic science learning' whereby they have the opportunity to understand and apply science in familiar contexts, with the potential to collect 'real data' (Glackin, 2016).

A growing body of evidence suggests that teachers' reticence to leave their classrooms stems from their pedagogical beliefs and self-efficacy (Dillon & Dickie, 2012; Glackin, 2016; Waite, Passy, Gilchrist, Hunt, & Blackwell, 2016), which is due in part to the uniqueness of each space (Tan & Atencio, 2016). In the UK, a call for increased professional development (PD) to enhance teachers' self-efficacy and expertise in incorporating outdoor learning has resulted in large encompassing projects such as the Natural Connection Demonstration (Waite et al., 2016), and smaller subject specific projects, such as 'Thinking Beyond the Classroom' (2007-09), that forms the focus of this paper. However, to date the sources of teachers' self-efficacy both generally and specifically to teaching outside the classroom, and the role that PD sessions play as a context for self-efficacy change, have been under explored (Klassen, Tze, Betts, & Gordon, 2011).

Until relatively recently, teachers' PD was typically characterized as the one-day stand-alone external provider-led session (Adey, 2004). As evidence has accumulated, the efficacy of this form of delivery to have long-lasting impact on teachers' practice has been questioned (Guskey & Yoon, 2009). Hence, over the past decade there has been a growth of PD programmes which are longer-term (e.g. 18 months – 2 years), occurring in both teacher's schools and through successive external 'sessions'. This shift in PD model has brought positive results and has been broadly welcomed (Jayaram, Moffit, & Scott, 2012).

Accepting the longer-term PD model as important for teacher reform, neglected is an articulation as to the form the PD 'session' should take to ensure maximum efficiency to support teacher change. That is, how should a PD 'session' - understood as a place where teachers and PD facilitators spend time away from schools/students discussing, sharing and reflecting on their teaching practice – be structured and what activities will best facilitate change? This question is particularly pertinent as education funding in many countries is increasingly constrained, requiring PD programmes to be more efficiently designed to ensure maximum outcomes.

Whilst school-based practice is a critical feature for practice change, for teachers to take pedagogical risks, I propose that the PD session acts not only as a space to share and develop practice but also as an opportunity to build teacher's self-efficacy to trial new ideas. As teachers are particularly concerned about teaching outside the classroom considering it risky (Glackin, 2017), the PD session has a particularly crucial role if more secondary teachers are to be encouraged and feel supported to trial this 'new' pedagogy.

This paper therefore explores how PD session strategies influence teachers' decision-making to trial new activities and their pedagogy when returning to school. To do so, I seek to move beyond questions of 'what works' to questions of what is it about these strategies that are influential when considered through a self-efficacy framework. Specifically, I ask: What professional development programme session strategies influence teachers' self-efficacy and motivation to trial activities outside the classroom? This question is especially important as whilst Morris, Usher, and Chen (2016) note, that the context of both the PD programme and the experiences of the teachers greatly matter, research remains limited as how these two combine specifically in the context of outdoor teaching in secondary schools (Christie, Beames, & Higgins, 2016). Further, inadequate research currently exists concerning the

influence of PD session strategies on in-service teachers' self-efficacy and motivation to trial new pedagogy in secondary schools in England.

1.1 Effective professional development

Professional development (PD) is both a continuous process, informed by an accumulation of experiences (often unplanned), and an activity with purposeful and focused outcomes to be achieved or acquired (normally planned) (Fraser, Kennedy, Reid, & McKinney, 2007). PD literature generally has focused on the latter premise, possibly due to it being an aspect that can be directly influenced and is accessible to research. A possible further reason for this focus is that the majority of PD programmes are designed in relation to reform efforts – where clear outcomes are to be achieved (van Driel, Meirink, Van Veen, & Zwart, 2012). Whilst this study's programme sought 'reform' and was focused on the (planned) processes and activities designed to enhance teachers' practice, the important role that the accumulation of experience has in informing teachers' self-efficacy (see, Glackin, 2016), which acts as a filter and guide for future PD implementation, was acknowledged (Wallace, 2014).

Notwithstanding the ambiguity of many PD programmes, van Driel et al. (2012), building on Desimone (2009), have categorized six critical features shared across PD programmes that make them effective in increasing teachers' learning. The features are: content focus, active and inquiry-based learning, collaborative learning, duration and sustainability, coherence and school organisation conditions. All the features can be identified across this current study's PD programme, their inclusion is highlighted below (see, Sections 2.1-2.2). Particularly pertinent to this study is the feature 'active and inquiry-based learning' which concerns the actual activities teachers undertake during the PD programmes. van Driel and colleagues (2012) assert that PD providers should give 'active learning' priority suggesting that the strategy enhances the programme's perceived relevance and usefulness to teachers' daily work. Examples of strategies affording 'active learning' opportunities van Driel and colleagues (2012) suggest include: observing expert teachers, being observed by other teachers and reflecting on and discussing these observations. In addition, Borko, Jacobs, and Koellner (2010), in their review of effective PD, identify modelling as an important strategy that effectively engages teachers in 'active learning'. They propose that modelling provides teachers an opportunity to experience a new pedagogy or activities as a learner and subsequently reflect on them. Borko et al. (2010) conclude that modelling is a very important

PD strategy having a significant impact on altering teachers 'normal' pedagogical methods. When viewed from a social constructivist perspective, that is learning which is socially situated and constructed through interactions with others (Vygotsky, 1978). Borko et al. (2010) suggest that the strategy provides an opportunity for teachers to construct new knowledge based on what they already know.

Whilst shining a light on critical features of PD so that they might be used to critique and inform current and future programmes, an explanation as to why PD features are considered valuable is currently missing from the literature. That is, for example, how are the effective 'active learning' strategies influential on teachers' professional learning? Or more specifically how do they influence teachers' self-efficacy resulting in pedagogical change? Below I explore what self-efficacy is and how it is influenced.

1.2 Professional development: Self-efficacy and Motivation

1.2.1 *Self-efficacy and motivation*

The origins of Bandura's theory of self-efficacy (1977) lay in Rotter's (1954) and Miller and Dollard's (1941) theories of social learning – that is, people learn through observation and internalization. From a social cognitive perspective, self-efficacy offers an explanation as to the underlying factors that affect a person's ability to achieve (Bandura, 1997). Situated within a wider belief system (Jones & Carter, 2007), Bandura (1997) argued that self-efficacy occupied a pivotal role; acting upon other classes of determinants – including beliefs, attitudes and motivation.

Self-efficacy is particularly useful because it is a measureable compound variable consisting of an outcome expectancy and a perceived self-efficacy. That is, self-efficacy acknowledges the importance of context dependency, aspiration, anxiety and relevance. In this study, for example, the outcome expectancy might be a teacher's generalized expectancy about a PD programme to have influence on their teaching methods in the outdoors based on their previous experiences. The perceived self-efficacy, on the other hand, might be a teacher's development of specific beliefs concerning their own capabilities to teach outside (Bandura, 1977). This contrasts with the notion of confidence, which is less clear, and indeed has been dismissed by Bandura as a 'nondescript term that refers to strength of belief but does not necessarily specify what the certainty is about' (Bandura, 1997, p.382).

A teacher's self-efficacy is important as it is said to inform their pedagogical decisions and affective state (Tschannen-Moran & Woolfolk Hoy, 2007). Further, self-efficacy has a significant influence on a teacher's commitment to the teaching profession (Chesnut & Burley, 2015) and how their classroom functions (Morris et al., 2016). A teacher with high self-efficacy and high outcome expectancies is thought to behave in a productive positive manner and gain personal satisfaction from their effort. In contrast, a teacher with low self-efficacy and low outcome expectancies is predicted to exhibit a behaviour of resignation, and an attitude of apathy. Self-efficacy is not static though. Murphy and colleagues suggested that PD programmes might enhance self-efficacy and in turn teachers' willingness to implement new pedagogical practices (Murphy, Neil, & Beggs, 2007).

Finally, noteworthy is Bandura's (1997) suggestion that the motivation to trial new pedagogy is rooted in cognitive activity and is enmeshed with self-efficacy. That is, when judgements concerning the future are cognized in the present time they can act as motivators and regulators of decisions for, and in, the future (Bandura, 1997). Using expectancy-value theory (Ajzen, 2002), the level of motivation a teacher experiences might be explained. That is, expectancy-value theory predicts that the higher the expectancy a teacher has of a practice to achieve a specific outcome and the more highly those outcomes are valued, the greater the motivation will be to trial the practice (Ajzen, 2002).

1.2.2 Sources of self-efficacy in professional development

Given the benefits accompanying high teacher self-efficacy, I turn now towards the four principal sources of information: mastery, vicarious, verbal/social persuasion, and physiological/emotional (Bandura, 1997). The first source, mastery experience, is the need for an individual to set a goal and then 'muster whatever it takes to succeed' (Bandura, 1995, p. 3). Successes are thought to build a 'robust belief in one's personal efficacy' (ibid.), however they should not be easy to attain as goals need to be challenging. Palmer (2011) went further identifying mastery experiences as 'enactive' and 'cognitive'. An enactive mastery experience is the act of teaching; a cognitive mastery experience is where the teacher understands the pedagogical concept being used to teach. Palmer (2011) suggests that offering teachers a theoretical background, and time to practice, enhances the opportunity to develop both enactive and cognitive mastery.

The second source is vicarious experience. That is, observing people (or one's self) attempting a challenge. Bandura (1995) explains that observing others succeed through perseverance raises the observers' self-efficacy. Conversely, observing failure, despite high personal effort, diminishes the observers' judgment in their own ability. Such experiences have greater impact where teachers consider the tutors/teachers modelling the learning are similar to them in terms of skills and experience (Palmer, 2006, 2011). A range of modelling types are identified as beneficial, including: 'effective actual modelling' – where an individual sees a person similar to themselves perform the task successfully; 'symbolic modelling' – where individuals are exposed to effective models provided by television and other visual media; 'self-modelling' – when the teacher is recorded for subsequent self-critique; 'cognitive self-modelling' – when individuals visualize themselves successfully performing a task; and 'stimulated modelling' where the tutor acts as the teacher and invites the teachers to assume the role of the students. It is noteworthy that van Driel et al. (2012) reported that there was limited research as to the role of the PD facilitator and their impact on a programme's outcomes. That is, what qualities of a PD facilitator are essential for effective PD?

The third source is social/verbal persuasion: where a teacher or tutor offers verbal assurance that a teacher possesses the capabilities to perform the activity. Bandura (1995, 1997) reflects that it is easier to undermine than increase self-efficacy through verbal persuasion. The potency of persuasion, again depends on the credibility, trustworthiness and expertise of the persuader – in this case, the teaching colleague or tutor. PD strategies offering opportunities for verbal/social persuasion include: lesson feedback from site-based teachers (Ross & Bruce, 2007) and programme tutors/lecturers and PD session discussions (Khourey-Bowers & Simonis, 2004; Palmer, 2006; Posnanski, 2002).

The final source of self-efficacy is a teacher's physiological and emotional state. We all judge our capabilities through different physiological 'states'. So, a positive mood might enhance self-efficacy, whereas a despondent mood might act to diminish it. In terms of PD there is limited research on how specific activities might be interpreted by teachers identified with particular emotional states (Milner, 2002). Professional development strategies which have been identified as having a positive influence on teachers' emotional states are: sequencing the introduction of pedagogical strategies from the least threatening (Bruce & Ross, 2008)

and consciously promoting a relaxed atmosphere of camaraderie (Khourey-Bowers and Simonis, 2004).

Although mastery experiences are considered as the most influential source of self-efficacy (Bandura, 1997), recent research suggests that it is more complicated, with multiple factors such as teacher's experience, their beliefs, and gender, influencing the overall effectiveness of self-efficacy sources (Britner & Pajares, 2006; Tschannen-Moran & Woolfolk Hoy, 2007). A further complication is that self-efficacy sources are not discrete; the effect of sources overlap (Usher & Pajares, 2008). For example, Milner (2002) found that verbal persuasion operated as a critical source until successful mastery experiences occurred. The limited studies that have investigated activities to enhance teacher self-efficacy have been dominated by pre-service primary education (for example, Palmer, 2006, 2011). Hence, how the nature of secondary science teachers' pedagogy, in this case teaching outside the classroom, might impact on the efficacy of the PD strategy on teacher change has not been explored.

2 Methodology

The purpose of this paper is to understand how elements of PD programme sessions were influential on teachers' self-efficacy and their motivation to trial new pedagogies and activities on returning to school. To this end, the study explores a two-year PD programme – 'Thinking beyond the classroom' – which aimed to enhance in-service secondary science teachers' pedagogy outside the classroom and co-construct ten outdoor science activities. Here broadly, the outdoors was considered as *a space without a roof*, that includes school playgrounds, sports fields, local green squares and parks (Glackin & Serret, 2011).

The professional development model was social constructivist in design, aligning with the philosophy which underpinned the pedagogy to be promoted by the participating teachers in school. That is, the PD programme offered propensity to promote exchanges that might lead to changes in beliefs and pedagogical practice (Glackin, 2016). It was accepted that to attain the goal of proficiency to teach science outside the classroom, the teachers would have to acknowledge their beliefs concerning teaching outside and be open to challenge their pre-existing frameworks. It was acknowledged that these challenges would raise issues concerning self-efficacy of teachers' ability to respond to the PD when back in school.

2.1 ‘Thinking Beyond the Classroom’ PD Programme

The PD programme and the (eventual) ten activities were underpinned by elements of two social constructivist pedagogical approaches with evidence for enhancing student attainment – Cognitive Acceleration through Science Education (CASE) (Shayer & Adey, 2002) and Assessment for Learning (AfL) (Black & Wiliam, 1998). That is, directed by the core approaches of CASE and AfL four underlying pedagogical principles were initially identified by the programme team to inform the development of the PD programme. These principles were: *observing the local; collaborative group work; learning through questioning and challenging thinking*. See Glackin (2016) for a summary of the practices considered characteristic for the pedagogic principles and Glackin and Serret (2011) for a full account of each principle. Hence, the principles were used to structure the ten outdoor science activities and informed the foci during the six PD sessions.

The ‘Thinking Beyond the Classroom’ programme followed the transitional/ transformative approach of Kennedy (2005) which adhered to the good practices as identified by van Driel et al. (2012). That is, the course offered opportunities for: an extended and continuous period for pedagogical change (that is, two years), strong links between theory and practice, strategies to prompt reflection on practice, the application of practice in different contexts (for example, visiting different outdoor settings) and the potential to build a ‘community of practice’ (between teachers from different schools and pairs of teachers in the same school).

2.1.1 ‘Thinking Beyond the Classroom’ Context

‘Thinking Beyond the Classroom’ was a joint venture between author’s affiliated university and the Field Studies Council which was funded by the Primary Science Trust (www.pstt.org.uk). Ten science departments in London state-funded schools were originally invited to participate. Collective participation was supported through six three-hour professional development sessions. Furthermore, two in-school observations by the programme team were completed to enable the development of the activities. Section 2.1.2 outlines details concerning the participants.

The team involved in the development, session facilitation and in-school observations during the programme consisted of the paper's author, four colleagues from author's affiliated university, and two staff representatives from the Field Studies Council, an environmental education charity. Noteworthy is that many of the team members were recognised nationally as experts in their field, which in terms of teacher self-efficacy, was a potential source for verbal persuasion (Palmer, 2006).

2.1.2 Participants

Eighteen secondary science teachers from ten secondary schools across Greater London enrolled onto the 'Thinking Beyond the Classroom' programme. During the first year of the programme, research data was collected with 12 of the 18 participating teachers. Five of the 12 participants withdrew from the programme and as such were not included in the study. Rather than the result of negative experiences from the programme, reasons for premature departure included: leaving the school to work outside London (two teachers); receiving promotion and having a lack of time; feeling unable to continue without a colleague on the programme; and, feeling over-committed to a number of professional development programmes. Furthermore, data from one participant was excluded from the study because they had not participated in the Year 1 observations or interviews. Following ethical approval for the study by the University ethics committee, written informed consent was gained from all research participants before the data collection commenced.

The resulting participants, Cara, Charlie, Claire, Megan, Michael and Tom, became the six case studies teachers (all names are pseudonyms). See Glackin (2016) for a summary of the case study teachers' specialist science subject, general teaching experience, school type, accessibility to outdoor space and previous outdoor teaching experience. All the teachers were early- or mid-career professionals – their experience ranged between two and eight years, and all had taught in only one or two schools. Four of the teachers had additional responsibility in their department. The majority of the participants reported that they had limited experience of teaching science outside. Three case study teachers reported participating in extended CASE PD; four reported having received extended AfL PD. Their science specialisms included biology, chemistry and physics. All the case study teachers taught Key Stage 3 general science (students between 11-14 years).

2.1.3 *‘Thinking Beyond the Classroom’: the sessions*

The sessions were broadly planned to be active offering opportunities for inquiry-based learning (van Driel et al., 2012). The foci was to introduce participating teachers to draft versions of the outdoor science activities written by the programme team, to develop pedagogical practice and to prompt feedback to be shared once activities were trialled. Teachers’ feedback, whilst used to refine the activities, also informed other participating teachers’ practices. Included in each of the sessions was a focus on one, or more, of the pedagogical principles underpinning the activities (see Section 2.1). Furthermore, the session focus varied over the two-years: the focus during Year 1 was on introducing new activities and pedagogies whereas in Year 2 the sessions focused on their development. Further the sessions were developed in response to teachers’ requests and their emerging expertise and programme team’s in-school observations of the trialled activities. For example, managing student learning outside became an explicit session focus following teacher feedback.

All the half day sessions were preceded by refreshments organized so that teachers had an informal opportunity to become acquainted, or in the latter sessions to catch-up. The activities and pedagogies were introduced and developed using different strategies with the aim to encourage teachers to trial the activities in school and use the pedagogies more broadly. For example, strategies used to introduce activities included: teachers’ reading through a paper-based activity and becoming familiar with the related ‘props’; teachers and tutors discussing and evaluating an activity following a brief overview from a PD tutor; teachers developing an activity in a small groups with limited PD tutor input (including the development of lesson questions through the use of a question prompt); teachers receiving only the activity and props to take away; tutors and teachers discussing the education theory and literature underpinning the activities; and tutors and teachers modelling an activity whereby they act as the teacher and the participating teachers act as the students. It was not assumed that all participants would engage with all of the strategies.

2.2 Data collection

Offered here, and in the following sections, is a detailed description of the methods and analysis used. This is in response to Morris and colleagues (2016) recent call for researchers to report the explicit prompts used to gauge sources of self-efficacy to ensure clear and

meaningful constructs are consistent with Bandura's self-efficacy concept alongside offering opportunities for study replications.

The paper reports data collected from: (1) participant session questionnaires and written reflections; (2) school-based lesson observations; (3) participant semi-structured interviews; and, (4) the programme's internal evaluator's session field notes and lesson observations.

The session questionnaires were completed by participants at the end of each of the six PD sessions. The questionnaire invited participants to rate their 'confidence' to subsequently trial the newly learnt activity in school (on a 0-9 scale) with a space provided for an explanation of their rating. For example:

Which part of the day did you find most rewarding? Why?

On a scale of 0 – 9 (0 being lowest), how confident do you feel to teach:

1. 'Rose tinted glasses' 0 1 2 3 4 5 6 7 8 9

2. 'Materials' 0 1 2 3 4 5 6 7 8 9

Can you explain your response?

Is there anything that you would like from us that would increase your confidence with the project and the activities?

As discussed above, self-efficacy is a more specific construct than confidence, however, as Palmer (2011) notes, the term is not widely understood amongst teachers. Hence, following Palmer the term 'confidence' was used in the questionnaires but was set within the context of a future performance.

The extended written reflections, completed on two occasions during the PD sessions, invited participants to explain their experiences of the outdoor lessons taught. Between one to four school-based lesson observations were conducted for each teacher over the programme's duration to observe how the teachers taught and substantiate what was reported during the interviews. Informed by the four principles underpinning the programme, an observation framework was developed to sharpen the observation focus.

Between two to four interviews were conducted with each participant over the programme's duration. On average, the interviews lasted 30 minutes; they were audio-recorded and transcribed. Interview questions eliciting insights of influential strategies included:

What do you see professional development as?
What were your impressions of the sessions?
How does the programme compare with other professional development courses?
What determined the choice of the activity that you have trialed?
Has participating in the programme influenced you or your teaching? Why did you continue in the programme?

The questions were purposefully open, a technique that Morris and colleagues (2016) found enabled teachers to talk more in-depth about their experiences leading to a more nuanced understanding of self-efficacy sources.

Finally, the data collected by the programme's internal evaluator, that included teacher and student interviews and lesson observations, was used in the analysis as offering more data, potentially a different perspective alongside an opportunity for increased trustworthiness (Denzin & Lincoln, 2008). The importance of a different perspective was heightened due to the duality of the author's role as researcher and as a PD programme tutor (British Education Research Association, 2011).

2.3 Data analysis

To identify programme strategies and factors considered significant in influencing the case study teachers' self-efficacy and practice the planned strategies used in the 'Thinking Beyond the Classroom' programme were identified and separated into three groups: those occurring during the sessions, those occurring in-school and those as occurring in 'other-settings'.

Pertinent to this paper is the former context – those occurring during the PD sessions – whereby five planned strategies were identified: trialling activities, reading through activities and 'props' presented, group discussion and activity evaluation, props/resource distributed and developing activities to trial.

The lists of strategies were initially used to analyse the data and they were altered when new categories emerged or sub-categories were identified. The advantage of having a list of pre-identified strategies was that any omitted strategies could be recognised. Table 1 presents all the session strategies identified.

-----Table 1 here -----

All data sources were used to identify the programme strategies. Lesson observations were used to substantiate claims made from other data sources by looking for evidence of the practice that the strategy was attempting to encourage/develop. Furthermore, evidence of the strategy's influence was occasionally evident in observed lessons having not been explicitly acknowledged through the other sources. For example, teachers were observed to use strategies for managing learning outside which were similar to those trialled during the sessions

Finally, using Bandura's (1997) theory of self-efficacy construction, strategies were categorised as potential sources of self-efficacy and motivation. That is, strategies were considered as providing potential opportunities for: cognitive mastery, enactive mastery, verbal/social persuasion, vicarious experiences and emotional/ psychological experiences or were motivational. To categorise the strategies, the case study interviews were returned to, or the session field-notes, and the context within which the strategy was discussed or took place was considered. For example, if the teachers discussed trialling an activity during a session as being influential, the field-notes were consulted to establish the type of strategy and potential source of self-efficacy. Data from the six case study teachers were analysed for sources of self-efficacy. The findings are the result of a cross-case analysis. Appendix A presents the programme strategies identified as potential source of self-efficacy.

3 Findings

Following the analysis, four themes emerged concerning planned programme strategies that positively influenced the six case study teachers' self-efficacy and their decision to teach outside the classroom on returning to school. These were: simulated modelling; resources and props; teachers' involvement; and theory input and tutor expertise. Strategies that were less successful are also reported. Table 2 presents the 'confidence' ratings given by teachers at the end of the session to trial the activities in school.

--Table 2--- here

3.1 Session strategy: Simulated modelling

Simulated modelling was identified as an influential strategy on the case study teacher's self-efficacy. That is, teachers' role-played students while programme tutors role-played the teacher. The five activities to receive high confidence scores at the end of the programme sessions (between 7.8-8.8) were all taught using this method.

Palmer (2011) and Bautista (2011) have both proposed that, in a PD context, simulated modelling is a significant self-efficacy source. Specifically, Bautista asserted that it offered vicarious experiences. The case study teachers appeared to concur that it did indeed act in this way. Megan, for example, reported that through simulated modelling: '[...] you feel much more confident - oh that's what you do, oh that's easy I can do that.' Which she claimed initiated her 'to kind of start and get better and better' (Megan, Interview).

As well as a potential vicarious experience, simulated modelling also offered an opportunity for mastery experience. In the past, mastery experiences were generally considered to only be attainable as a result of teaching experiences and not achievable in PD sessions (Bautista, 2011). However, following Palmer's (2011) recent re-conceptualisation of mastery sources, simulated modelling qualifies as offering an opportunity for mastery experiences. That is, where Palmer (2011) re-defined mastery experiences as being: enactive mastery, that is perceived success in the actual teaching of science, and cognitive mastery, that is perceived success in understanding a pedagogical concept he went on to propose that cognitive mastery could be achieved through all aspects of a PD programme, whereas enactive mastery was only available to teachers when they were teaching their students. Hence in this study, simulated modelling may have acted as a source for cognitive mastery experience, which offered the case study teachers the ability to perceive success in understanding a pedagogical concept.

Two further reasons emerged as to why simulating modelling acted as an influential strategy on teachers' self-efficacy. First, the strategy was identified to offer teachers an opportunity to develop empathy for how students might experience the activities. As Claire suggests in her session questions: 'Trying out the various activities gives you real insight into how your students may approach things.' This notion of empathy formation through simulated modelling was also noted by Cara: 'Actually getting a chance to try the activities yourself.

Just getting the chance to put yourself into the kids' shoes, really. That was really valuable (Cara, Interview).

Perhaps the opportunity for empathetic development acted as a physiological and emotional source of self-efficacy. So, I propose that rather than informing self-efficacy directly, the teachers experience of empathy for their students' learning may have contributed to a positive affective state resulting in their trialling an outdoor lesson.

Second, simulated modelling offered the teachers an opportunity to become quickly familiar with the activities as was suggested by Michael in this exchange:

I: What was useful about the professional development sessions?

Michael: I think it's good because of the sort of hands-on nature of it [...] that when we were given an actual practical to do, it was go out there and do it, and then you have to go through the whole process, and you can see where the sticking points might be. When you are just teaching something and you are sort of slightly above it, from that, you are so engrossed in knowing what is going on and trying to learn it that you can sort of miss out on the sort of small stumbling blocks that they [the students] might come across.

(Michael, Interview)

In this instance for Michael the strategy offered an insight into potential pitfalls and difficulties which, as a teacher, one could avoid by introducing the task in particular ways. It makes the practical more 'known' and 'owned' and thus less abstract/ conceptual. Here, the interplay between cognitive and enactive mastery can be seen.

With simulated modelling potentially offering three sources of self-efficacy – vicarious, cognitive mastery, physiological and emotional, the substantial influence the strategy had on the case study teachers can be understood. Bruce and Ross (2008), who similarly identified that teachers' self-efficacy was influenced by combinations of self-efficacy information, proposed that incoming self-efficacy information worked to reinforce one another. They suggested that when self-efficacy was positive, the accumulative effect encouraged risk-taking and the implementation of challenging pedagogies.

In contrast for the case study teachers, when activities were introduced through non-participatory strategies such as 'read-through only' or stimulated discussion where props were displayed, a reverse influence on teachers' self-efficacy and willingness to trial them was observed. For example, Air pollution, Materials and Turning over a new leaf were activities introduced using non-participatory methods initially. Table 2 presents that these activities received low average confidence ratings by teachers: 5.2, 5.3 and 6.4.

Teachers reported that the ‘read though only’ strategies were problematic as the text did not transmit a true sense of the ideas. The session strategy triggered different responses from the case study teachers. Claire, for example, rejected trialling an activity:

I think *Turning over a new leaf* was one of the ones that we didn’t have time to go through in the PD [session]. It was more – here is the lesson plan. So I don’t really feel like I know what the lesson is like and whilst I am sure if I sat down properly and read the notes I could make sense of it, it’s that I do not really know what it is about so I will leave that one and do the ones I do know something about.

(Claire, Interview)

Whereas where Megan trialled the same activity, and experienced a negative outcome, she blamed this on the original strategy used for dissemination. This is noteworthy as in general Megan had successful out-of-classroom lesson with her students when transferring activities into taught lessons:

Where I think if you’re just given something and say this is what you’ve got to do the research and reading up behind it making sure you know what you’ve got to do is actually quite hard sometimes, and you don’t always have time. And the first few you do are a complete nightmare, you think well actually I’m not going to do that again it was a disaster.

(Megan, Interview)

Further, Claire, invited to suggest improvements to the PD sessions captures the need for sessions to include opportunities to trial all activities, highlights session constraints due to limited time:

I: What suggestions do you have for improvements to the professional development days?

Claire: [...] I think without making the sessions any longer, it would be difficult to do them in a different way, and yet still achieve everything. I think some of the sessions – we could do with going through more of the activities. Because initially we tended to do [teach] the activities that we’d gone through on the sessions. And the others, like the Back to the Sun one, where they just gave us the lesson plans, we were quite slow doing it [teaching it] – we did the ones we’d go through ourselves first at school. So I think modelling all the activities would’ve been useful – because the ones we didn’t model we just didn’t do (initially).

(Claire, Interview)

3.2 Session strategy: Resources and props

All the case study teachers acknowledged that they were more inclined to trial an activity when they were presented with a related resource or prop during the PD session. Resources were referred to in two respects: those distributed at the session – for example, filter eye-glasses and fold-out identification keys – and those to be acquired to teach the lesson – for example, egg boxes, balls, paper arrows and cameras.

The physical presence of the resource acted as a reminder of the activity once the teachers returned to school. Bandura (1997, p.90) connects the role of reminders with vicarious experiences when he says, ‘people cannot be much influenced by modelled events if they do not remember them’. The prop during this programme acted as a reminder of the session, potentially becoming an extension of a vicarious experience. Bandura proposed that memory was aided by symbolic transformations of modelled information into memory codes and cognitive rehearsals of the coded information. That is, the props might have worked as a tool that triggered the memory when the teacher returns to school to trial the newly introduced pedagogy.

The props also provided novelty, stimulating teachers’ interest to trial the new activities. Novelty here is understood as ‘a level of unfamiliarity or newness’ (Palmer, Dixon and Archer, 2016, p.1058). Tom, for example, discussing the filter eye-glasses, noted that the resources offered an opportunity for fun alongside an unfamiliar experience he wanted his students to enjoy:

Because I remember, particularly the Rose Tinted Glasses one, Zara [Tom’s colleague] and myself were outside in the park there, and we were laughing like idiots, we were having a great time, just looking at things and seeing how everything was going. And that made us think this is good, if we like it this much the kids will like it, and it will be great fun – look at this, look at this! Because me and Zara were looking at things – what colour do you see? Ooh, what do I see? And it was actually fascinating, and it fascinated us, the same with the kids.
(Tom, Interview)

Claire echoed Tom’s opinion, adding that there were latent opportunities for novelty in the resources:

I think the Rose-tinted glasses because it was fun and it had fun aspects to it and also because we were doing a whole topic on radiation last year with Year 9 it fitted really well.
(Claire, Interview)

Hence the novel property of the prop, observed during the PD session, acted to motivate pedagogical action back in school. There is a growing body of research that suggest that novelty is an important aspect of motivation, or as Ainley, Hidi, and Berndorff (2002) refer to it as, situational interest. That is, situational interest as a short-term psychological state, can have a significant effect on learning. The novel prop/ experience acts as a catalyst. Although novelty is a transient phenomenon, Palmer et al. (2016) have suggested that situational interest can result in very focused attention, that can be correlated with behavioural and cognitive engagement (Sun & Rueda, 2012).

3.3 Session Strategy: Teachers' involvement

The third theme emerging as influential on teacher's self-efficacy was how they, and colleagues, were involved in the programme sessions. Guskey and Yoon (2009, p. 496) referring to involvement as 'active-learning experiences', similarly acknowledged the importance of teacher involvement for effective PD workshops. *Involvement*, in this study, related to the case study teachers participating alongside colleagues during the sessions, leading aspects of sessions and being active in developing the activities. For example, when asked: 'Which part of the day did you find most rewarding? Why?', the teachers frequently responded with: 'Group feedback on activities', 'Discussion about new activities' (Cara, Session questionnaire) and 'Sharing good practice' with and between other teachers (Charlie, Session questionnaire).

Further, the importance of the co-construction of the activities was expressed by Charlie:

I: Is the professional development different from other programmes you've been involved in?
Charlie: I enjoy the sessions we've had [...], the opportunity to be involved in the development of something – and it does feel like we are involved in the development of it - that our ideas are useful to construct a programme (of activities).
(Charlie, Interview)

Teachers reported the planned 'group discussion' provided two key benefits. First, for Tom the strategy was an opportunity to illicit guidance on activity implementation and work through solutions to pedagogical problems: 'Talking to people who have done activities I haven't tried yet to get some guidance' (Tom, Session questionnaire). Second, the group discussion acted as a tool for reflection – a time to digest what had been presented or previously undertaken in school:

[...] you've discussed the problem areas, not all of them, but a lot of the key things, so that when you go back in school you feel confident that you can go ahead and do something. So not just that it's this new idea. Because I think quite often you can come back from InSET where you are talked at, and you can come back and go – that's a great idea, oh it will never work, I couldn't do that.
[...]
I think it gives you a chance to reflect on what you are doing anyway, because when you are talking about the ideas, quite often things are given a particular name, and it's not until you are talking about it that you go – oh actually I do something similar to that already.
(Claire, Interview)

In the extract above, the strategy of collegial discussion acted to increase Claire's self-efficacy, resulting her to trial new approaches in school.

Hence, through planned group discussion two potential sources of self-efficacy were identified. The first was an emotional/psychological source. As Richardson (1995, p. 66) explained:

Having time to talk to one another is one of the most effective ways of defusing stress. It allows people to share self-doubt, express anxiety about their competence, and exchange ideas they are really proud of.

This source, and therefore the explicit need to plan in frequent opportunities for it, is often overlooked. Morris and colleagues (2016) assert that the underestimation of the importance of teachers talking together, and having opportunities for emotional and psychological experiences, is possibly due to the outcomes from discussion being ongoing and accumulative rather than episodic. Therefore, unlike episodic strategies, the outcome of ongoing strategies are more challenging to capture.

Second, group discussion offered an opportunity for verbal persuasion (Bandura, 1997; Khourey-Bowers & Simonis, 2004). Bandura proposed that verbal persuasion has an optimal effect when a teacher believes the source is credible and has expertise (Bandura, 1997). More recently, Morris et al. (2016) asserted that verbal persuasion, also referred to as social messages, were particularly powerful when a teacher had less experience in a particular pedagogy or teaching context. For participants in this study the pedagogies were: open questioning and managing learning outside the classroom. As this study took place over two years, relationships between the participants had time to mature and evolve. The teachers become credible sources to one another, as they implemented the activities with similar age students, curriculum constraints and in similar contexts. The credibility of other's opinions increased over the sequence of the sessions as the teachers' familiarity grew. This sentiment is captured by Cara:

I think it's working with the same people as well, and sharing practice, which quite often at INSETs it's people talking at you, and not necessarily sharing your ideas and your thoughts about things, so I think that was a different approach.
(Cara, Interview)

The notion of teachers seeing other PD participants as credible sources of self-efficacy was particularly evident when teachers presented techniques addressing the management of student learning outside the classroom. That is, acting as a potential source of verbal persuasion, the participating teachers' pragmatic advice – informed from recent in-school experiences – was considered authentic. Such advice included, how to facilitate starters and plenaries outside, how to gain attention and how to efficiently move students in and outside the classroom. Claire explained that the advice gave her the confidence to use the idea 'so you know you can do it'. The method also encouraged preparation and planning:

[...] knowing you could do it, but knowing that you've thought it all through. We've talked about anti-bacterial hand-gel, how do you organise them outside, what do you do, do you tell them where the boundaries are?
(Claire, Interview)

Finally, involving teachers in the development of the activities served to acknowledge their own expertise. It also offered teachers an opportunity to think critically about their practice and consider how it related to educational theory. The influence that co-construction had on practice corresponds with Henson's (2002, p. 143) findings that for PD programmes to influence self-efficacy they need to 'compel teachers to think critically about their classroom and behave actively in instructional improvement'. Perhaps, evaluating and developing activities offered participant teachers the opportunity to think critically, potentially offering an opportunity for cognitive mastery experiences (Palmer, 2011).

3.4 Session Strategy: Theory in-put and tutor expertise

Alongside fellow teachers, programme tutors were also considered credible sources for verbal persuasion. Claire, for example, said, 'It was good because you knew that they knew what they were talking about' (Claire, Interview). Guskey and Yoon (2009) have similarly acknowledged the important role the 'expert' plays in effective professional development, as has van Driel et al. (2012), who, however, notes that little is understood about the relationship between the role of the PD tutor, their expertise and the effective PD outcome.

In this study, tutors' 'credibility' or 'knowing what they were talking about' was entwined with the teachers' knowledge of the PD programme's theoretical underpinning. The programme's theory was explicitly shared with the teachers, and consistently returned to during the sessions. This sentiment was particularly acute amongst case study teachers who had previously worked with the university tutors and/ or had previous knowledge of the theoretical framework; these teachers were observed as being more successful in their implementation of the programme activities.

So, for example, the three teachers who had previous experience of teaching CASE lessons and understood the theory, were observed implementing cognitive conflict strategies; whereas the three teachers with limited CASE experience were less frequently observed to do so. The influence of theoretical/ practice experience is apparent in the extracts below where Michael and Charlie, two teachers with different CASE experiences, comment on cognitive

conflict within the Urban Jungle activity. Michael has less limited experience of the CASE programme, and comments that he is unable to identify ‘conflict’ in an activity:

Some of them had, some of them more than others had conflict. Like the Egg Box one sort of had some conflicts in terms of what’s a gas and solid, and then you can swap around between some of those. So that was good. The Urban Jungle one, today, I am not sure if there was any particular conflict in there, or maybe there was and I didn’t integrate it into it. But so, I mean, where there is, I try and get them to have cognisance that there is such conflict going on and then try and get them to integrate it.

(Michael, Interview)

In contrast, Charlie who has more experience of the CASE programme, was able to identify a opportunity for student cognitive conflict:

I: Within the lessons where have you seen cognitive conflict?

Charlie: With the *Urban Jungle* one, it’s with the ‘what is a habitat’? Is it this kind of barren place that you’re telling me is a habitat so why is that. Is it this picture where there are animals sitting there but, you know, really a habitat? That is where the sort of confusion and thinking was coming about at the beginning of the lesson - that they were then able to resolve the rest of it. For that one it came quite early on.

(Charlie, Interview)

The requirement for an explicit theoretical rational is highlighted by Charlie when he postulates that participant teachers less experienced in CASE might struggle to implement the programme strategies concerning cognitive conflict as he viewed that not enough of the underpinning theory/research was made available during the sessions. Viewed in this way, the session activity which asked teachers to identify the challenge or conflict in the activities acted as a source of cognitive mastery only to those teachers who already understood the concept. For those with less experience the activity helped little and the concept remained abstruse. This finding is consistent with Fraser et al. (2007) who conjecture that for transformative professional learning to take place, strong links between theory and practice are consistently necessary.

4 Discussion

This paper has considered how PD programme session strategies influence teachers’ self-efficacy to trial new practices on returning to school. Previous research has frequently identified mastery experience as the most influential source on teachers’ self-efficacy (Bandura, 1986; Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). However, in line with Brand and Wilkins (2007) and Bruce and Ross (2008), whilst this study does not dispute the important role in-school enactive mastery experiences play, the findings raise questions about the significant, currently under-researched roles, that the other sources of self-efficacy have on PD programme effectiveness.

Table 3 summarises the session strategies and the sources of self-efficacy and motivation they offered. The evidence from this small exploratory study support Brand and Wilkins (2007) proposal that the other self-efficacy sources – vicarious, verbal/social persuasion and emotion physiological – not only act directly on teacher self-efficacy to trial new activities but, mediated often by the enactive mastery experience, influence cognitive mastery experiences. Hence, whilst enactive mastery experiences are important, the findings suggest that it is how they inform cognitive mastery experiences that influences a teacher’s self-efficacy and resulting pedagogical practice.

----- Table 3-----

So, it is possible that where a strategy offers access to a greater number of self-efficacy sources the efficacy information becomes strengthened. Indeed, this might explain why ‘simulated modelling’, where teachers acted as students and tutors as the teacher, emerged as a key influential PD strategy for the participants in this study. That is, the findings suggest that simulated modelling offered vicarious experiences, enactive and cognitive mastery experiences, alongside potential physiological and emotional sources of self-efficacy. However, alongside the number of sources on offer, I argue it is crucially how the sources combine, through the strategy, to ultimately inform a teacher’s cognitive mastery experience. Hence, in this study simulated modelling offered teachers enactive mastery experiences through trialling the activity, vicarious experiences through the ‘expert’ tutors and experienced teachers, and access to physiological and emotional sources when learning was viewed from the student’s perspective. During the strategy, the three sources collectively supported the teacher’s ability to access the theoretical rationale for the pedagogy when explicitly articulated. That is to say, the combined sources strengthen the teachers’ cognitive mastery experience. Further, the findings are similar to other studies concerning PD effectiveness (van Driel et al., 2012), where the requirement for a shared and understood theoretical underpinning are highlighted. The inclusion of this aspect within the strategy offers teachers access to cognitive mastery sources.

The findings also suggest that PD strategies are motivational. Two categorises of motivation were identified. First, strategies promoting a will to observe student responses (for example, novel practical ideas) and second, strategies serving as a reminder, or as ‘symbolic memory

triggers'. I postulate that rather than just being an object or experience, a motivational item offers situational interest (Ainley et al., 2002), representing a potential goal that the teacher might achieve. In the first category teachers want to achieve the goal of observing a positive response from their students. The prop or PD experience only becomes a motivator once a goal to achieve this outcome has been attached. For example, the teacher may experience a novel activity during the PD session and believe their students' will benefit from undertaking it. The experience, now a memory, acts as a reminder of that positive experience which they want to re-enact. Further, I propose that 'motivators' might contribute to teacher self-efficacy. That is, they acted to inform the teacher's goals, and, therefore, outcome expectancy. Bandura wrote extensively about motivation processes and their relationship with the efficacy belief system (see Bandura, 1997). However, my proposal that props and experiences might offer latent outcome expectancy stimuli has not been commented on in previous self-efficacy-related studies.

4.1 Implications and future research

The findings from the present study need to be considered in light of several limitations. First, the data sets on which the findings are based are small. Six teachers were studied in-depth. However, the study does present findings for teachers who engaged in a social constructivist informed outdoor science PD programme over an extended period. Of the participant teachers studied, there is nothing to suggest that they were either atypical or exceptional. Rather, all the case study teachers reported 'normal' constraints on practice—similar to those reported in the literature (e.g. Lock, 2010).

Second, the duality of my role as researcher and programme tutor was potentially problematic. I undertook a number of mitigating measures towards impartiality and to engender trustworthiness in the findings. These included member checks, that is, several teachers were invited to read and comment on their written case studies; external checks, that is, on several occasions colleagues discussed and offered alternative insights into the research themes emerging from the data; and intra-data checks achieved through the interval evaluator's independent observations and interviews (Denzin & Lincoln, 2008).

Finally, this study only reports the short term influence of PD strategies on teachers' self-efficacy and practice, however I acknowledge that the influence of PD strategies might lay

dormant, becoming accessible when teachers are, for example, in a new context or have a new experience. Wyatt (2016) proposes that teachers might be able to access such latent sources if their pedagogical knowledge significantly increased. This chimes with the findings above concerning the strength of pedagogical knowledge acting as a source of self-efficacy.

Arising from this study there are two key practical implications for PD programme developers. First, PD sessions should include opportunities for simulated modelling. However, where in the past PD developers might have included the strategy to offer variety or make the session interactive this study suggests that it's inclusion might be far more impactful on PD outcomes. Second, opportunities to include props into PD programmes should be sought as they can work to provide memory prompts – and possibly stimulate cognitive mastery experiences – whilst also being engaging and promoting interest. The props do not have to be novel or 'special', but it is rather what they represent and therefore how they are introduced and used that provides the motivation.

As to future research, this study has only begun to explore sources of self-efficacy in terms of PD programmes. Research, that would complement this study, called for over a decade ago by Milner (2002), would be to explore how specific PD activities are interpreted by individual teachers identified with particular psychological and emotional states. With many teachers reporting feeling under confident and anxious about teaching students in new settings (Glackin, 2017), this research would be particularly pertinent if it offered PD tutors a greater knowledge how specific PD strategies, and how they might be best sequenced, could be targeted at teachers with particular emotional states.

Word count: 8700

Appendix A PD strategies identified as potential sources of self-efficacy.

Programme context	Strategy	Potential Source of Self-efficacy
Session (Focus on whole activity)	Activities ‘acted out’ – tutor –led simulated modelling	Cognitive mastery experience Vicarious experiences
	Activity read through and ‘props’ presented	Verbal persuasion
	Group discussion and evaluation of an activity	Verbal/social persuasion Emotional/psychological experience
	Activity developed within a group	Verbal /social persuasion Cognitive mastery experience
	Receipt of activity props/resources	Verbal persuasion
	Receipt of activity lesson plan: clear obj/NC links	Verbal persuasion
	Clear pedagogical framework - transferable to other lessons	-----
	Authenticity of programme - theory and tutors	Cognitive mastery experience
	Sequence of sessions with follow-up/review	Cognitive mastery experience
Session (Focus on specific principle of pedagogy framework)	Principle: Observing the local	Cognitive mastery experience
	A tutor-led activity to develop teaching observation skills to students	
	<i>Principle: Collaborative group work</i>	Verbal persuasion Cognitive mastery experience
	Tutor presented theoretical and practical ideas on group work	
	<i>Principle: Provoking challenge</i>	Cognitive Mastery and verbal/social persuasion
	An activity to identify the ‘challenge’ in the lesson activities through discussion	
	<i>Principle: Learning through questioning</i>	Cognitive mastery experiences
	Writing questions for the activities with the support of ‘question stems’	

Session (Focus on student managemen t)	Strategies to manage students presented by a participating teacher	Verbal persuasion
	Strategies to manage students outside shared in groups	Verbal persuasion
	Strategies to manage students outside presented by tutor during activity teaching	Vicarious experience Cognitive mastery experience

Table 1 Professional development session strategies

Category	Code
Programme session (<i>Focus on whole activity</i>)	<p>Activity read through and ‘props’ presented</p> <p>Group discussion and evaluation of an activity</p> <p>Activity developed within a group</p> <p>Receipt of activity props/resources</p> <p>Receipt of activity lesson plan: clear obj/NC links</p> <p>Sequence of sessions with follow-up/review</p> <p>Authenticity of programme - theory and tutors</p> <p>Clear pedagogical framework - transferable to other lessons</p>
Programme session (<i>Focus on specific aspects of pedagogy framework</i>)	<p>A tutor-led activity to develop teaching observation skills to students</p> <p>A teacher-led activity to develop student observation</p> <p>Group work Theoretical ideas presented on group work</p> <p>Cognitive conflict (CC) An activity to identify the CC in the lesson activities through discussion</p> <p>Questioning Writing questions for the activities with the support of ‘question stems’</p>
Programme session (Focus on student management)	<p>Strategies to manage students outside presented by a participating teacher</p> <p>Strategies to manage students outside shared in groups</p> <p>Strategies to manage students outside presented by tutor</p>

Table 2 Teachers' confidence rating for 'Thinking Beyond the Classroom' lesson activities

Data source - Session questionnaire (Confidence scale 0-9 (0 as lowest))

		Case study participant secondary science teacher						
Session activity introduced	Activity name	Megan	Claire	Charlie	Cara	Tom	Michael	Activity average
1	Eggbox	9	9	9	8	-	9	8.8
	Forces around us	7	8	7	8	-	9	7.8
	Back to the Sun	6	6	7	6	-	6	6.2
	Turning over a new Leaf	6	6	8	6	-	6	6.4
2	Rose tinted glasses	9	8	6	6	3	7	6.5
	Materials	7	5	5	7	8	3	5.8
3	Our school: Urban Jungle	8	7	9	-	9	8	8.2
	Air pollution	6	3	5	-	6	6	5.2
4	Observation 1 & 2	9	8	7	-	-	9	8.3
Confidence average		6.4	6.7	7	6.8	6.5	7	

*over two-years, across year groups

Table 3 Sources of self-efficacy and motivation identified in effective PD programme session strategies

Strategy	Sources of Self-Efficacy / type of motivation					
	Enactive mastery	Cognitive mastery	Vicarious experience	Social & verbal persuasion	Physiological & emotional state	Motivational
Simulated modelling		√	√		√	√
Resources and props			√			√
Teachers' involvement		√		√	√	
Theory in-put and tutor expertise		√		√		

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